the green design lab™

YOUR BLUEPRINT FOR A HEALTHY AND GREEN SCHOOL

Energy K-5 Teacher's Guide

SOLARone

GREEN ENERGY, ARTS & EDUCATION CENTER

the green design lab™

Your blueprint for a healthy and green school

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Acknowledgments

About Solar One

"Green Energy, Arts, and Education Center." We inspire New Yorkers to become environmentally responsible city dwellers. Solar One offers innovative programming to K-12 students throughout all 5 boroughs of New York City in the areas of renewable energy, sustainable design, estuarine ecology and environmental art.

The mission of Solar One's education program is to facilitate applied experiential learning opportunities through science, design, art and entrepreneurship. Our staff of educators are here to help you make the Green Design Lab an integral part of your school's curriculum and learning objectives.

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Energy Unit

This unit introduces students to conventional methods of energy production, energy infrastructure and its impacts on human health and the environment. Students will investigate the science of electricity as well as energy conservation strategies and forms of renewable energy. Using the school as a learning laboratory, students will explore the concepts of building science and energy efficiency. Students will also consider new technologies and applications through a series of hand-on projects.

How to Use

Curriculum Map

Each lesson plan contains background information and several activities. The Curriculum Map aligns each of the activities with the appropriate grades.

Activities	Kindergarten	1st	2nd	3rd	4th	5th
Lesson E1						
Activity E1a Energy Charades	X	X	X			
Activity E1b Sun Worksheet	X	X	X	X	X	X
Lesson E2						
Activity E2a Light Bulb Worksheet	X	X	X			
Activity E2b Power Plant Hook Up			X	X	X	X
Lesson E3						
Activity E3a Energy Detectives	X	X	X			
Activity E3b Kilowatt Matching Game			X	X	X	X
Activity E3c Classroom Energy Audit				X	X	X
Lesson E4						
Activity E4a Turn Off the Lights!	X	X				
Activity E4b Poster Campaign		X	X	X	X	X
Lesson E5						
Activity E5a Battery Worksheet	X	X				
Activity E5b Creating Circuits			X	X	X	X
Activity E5c Magnet Motors					X	X
Lesson E6						
Activity E6a Renewable Coloring Books	X	X				
Activity E6b Exploring Renewable Energy					X	X
Lesson E7						
Activity E7a Pinwheels	X	X	X			
Activity E7b Wind Turbines			X	X	X	X
Lesson E8						
Activity E8a Solar Beads	X	X				
Activity E8b Sundial Watches			X	X	X	X
Lesson E9						
Activity E9a Stuffed Suns	X	X				
Activity E9b Solar Racers	X*	X*	X	X	X	X
Lesson E10						
Activity E10 Solar Cooker	X	X	X	X	X	X

*** See NOTE: in Activity**

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Lesson E1 Intro to Energy

What is Energy?

So what exactly is energy? The word energy has its roots in the Greek word, ergon, which means work. Energy is the ability to do work. Common forms of energy include stored *(potential)* energy, motion *(kinetic)* energy, chemical, light, heat and sound.

Energy may be thought about in a number of ways. In ecology, for example, energy is the flow of resources through the food chain. All living organisms depend upon some form of energy for survival. The sun is our planet's greatest source of energy, providing light and radiant heat. The sun also drives photosynthesis – the process by which plants produce their own food. Plants, in turn, provide food, habitat and other resources for animals, insects and other living organisms. All living organisms on our planet are fueled by sunlight.

Eating, drinking and sleeping give us energy to perform our daily activities such as running, thinking, working and going to school.

Photo: Michael Gray, Wikimedia Commons

In the table below, note the different types of potential and kinetic energy. How may the types of potential energy listed be transformed into kinetic energy? For example, an apple hanging on a tree has gravitational energy (potential). When the apple falls off the tree its energy changes into kinetic energy, the energy of motion.

Types of Energy

Potential Energy: Potential energy is stored energy and the energy of position	**Kinetic Energy:** Kinetic energy is motion - of waves, molecules, objects and substances.
Chemical Energy is energy stored in the bonds of atoms and molecules.	Radiant Energy is electromagnetic energy that travels in waves. Light is one type of radiant energy.
Mechanical Energy is energy stored in objects by tension.	Thermal Energy, or heat, is the vibration and movement of the atoms and molecules within substances.
Gravitational Energy is energy stored in an object's height.	Motion Energy is energy of the movement of objects.
Electrical Energy is delivered by tiny charged particles called electrons, typically moving through a wire.	Sound is the movement of energy through substances in longitudinal (compression/rarefaction) waves.

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Activity E1a Energy Charades

Objectives: Students will...

- Identify various activities that require energy.
- Understand concept of energy.

Time: 30 minutes
Location: Classroom

Discussion: What is energy and how do we use it? Ask students to think about what gives us energy.

1. Have students play a game in one large group.
2. Tell each student to think of an activity that uses energy. They should not tell anyone their idea.
3. Choose one person to go first. Using only body language – no sounds or words – the students should act out their activity. If they use any sounds, they lose their turn.
4. Other students must guess the activity. The first person to correctly guess the activity is the next to act out his or her idea.

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Activity E1b Sun Energy Worksheet

Objectives: Students will...

- Understand the concept of energy in relationship to the sun.
- Identify various activities that rely on the sun's energy.

Time: 30 minutes
Location: Classroom

Materials:

- Sun Energy Worksheet
- Pencils
- Markers

Discussion: Ask students to think about what we eat (vegetables, meat, etc). How do these things grow? Drive the discussion toward the idea that all life on the planet relies on the sun's energy. Animals eat plants or eat other animals that eat plants. All plants, i.e. fruits and vegetables, need sunlight for photosynthesis.

Grades K-3: Sun Energy Worksheet. Students will draw pictures of activities, plants, animals, etc. that rely on the sun's energy.

Grades 4-5: Sun Energy Worksheet, students will draw pictures of activities, plants, animals, etc. that rely on the sun's energy. Students may draw lines connecting their pictures to illustrate the relationship to the sun's energy in a food chain-like manner.

For the Students:

Activity Worksheet: F1b Sun Energy Worksheet

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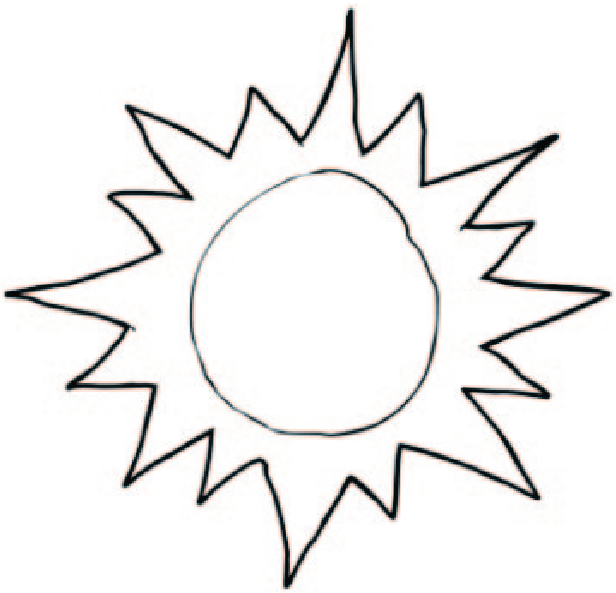
Activity E1b Sun Energy Worksheet



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Lesson E2 Electricity 101: The Basics

Electricity is one form of energy. It is both a part of nature (Remember Benjamin Franklin flying a kite in a lightning storm?) and one of our most widely used forms of energy. Electricity powers many things we use everyday – lights, cell phones, computers, and even your school building. It is important to remember that electricity and energy are not the same thing. Electricity is one type of energy. For our purposes, electricity is the flow of an electric charge (electrons or charged particles) along a conductor.

Photo: Steven Codrington, Wikimedia Commons

Most of the energy we consume (primarily electricity and heating fuel) is made from fossil fuels. Fossil fuels are minerals and elements from the earth formed over millions of years, which contain stored energy. Think of fossil fuels like batteries. In order to unlock their energy, fossil fuels must be burned.

The three main forms of fossil fuels are:

Oil - Also called petroleum, oil is a thick, black liquid found underneath the Earth's surface. To get oil, a well is dug and the oil is pumped out. The oil is then taken to refineries where it is changed into gasoline and jet fuel. It is also burned in power plants to make electricity.

Natural Gas – Natural gas is also found underground near oil reserves. It is also pumped out of the ground through pipes. Because natural gas has no color or smell, a chemical is added to it when it is pumped out, giving it a bad smell. This way it is easy to detect leaks in the well. Natural gas is used for heating and cooking in homes and is also burned to create electricity.

Coal – Coal can come in many forms – from hard, black rocks to soft dirt. A lot of coal is found just under the Earth's surface, often in mountainous areas. It is mined, meaning holes are dug or created with explosives and the coal is taken out. Most coal is burned to generate electricity. Over half of the electricity in the United States is produced by coal.

Most power plants in the United States burn fossil fuels to create electricity and most of today's heating systems also require fossil fuels to operate. To make electricity, these energy sources are placed in a large furnace and used to heat water into high-pressure steam. The steam drives a large rotary machine called a turbine. The steam spins the turbine, which is attached to a generator. The generator consists of a magnet surrounded by copper wire. When the rotation of magnets against the copper occurs, an electric current is created. This electrical current is then sent to a transformer where the voltage is increased and distributed to transmission lines, eventually making its way to your home or school.

The way we make electricity affects your health and the environment. Burning fossil fuels produces a lot of smoke and pollution. The pollution released from a power plant is dangerous to both people and the environment. It contains particulate matter as well as air pollutants such as nitrous and sulfur oxides and mercury. These pollutants emitted into the air can lead to respiratory problems like asthma and even more serious health issues such as cancer. Power plants also release a large amount of greenhouse gases like carbon dioxide (CO_2). These gases collect in the Earth's atmosphere, trapping heat and UV rays from the sun inside, thus increasing the Earth's surface temperature, causing climate change. Rising sea levels, loss of arable land, loss of potable water and loss of species are a few possible outcomes of climate change.

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Lesson E2 Electricity 101: The Basics

Electricity's Impact on the Environment

Emission Types	Emissions of carbon dioxide (CO_2), carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen oxides (NO_X), particulate matter (PM) and heavy metals such as mercury
Air Quality	Particulate Matter (PM) results in hazy conditions in cites and scenic areas. Along with ozone, PM contributes to asthma and chronic bronchitis, especially in children and the elderly. Very small, or "fine PM" is also thought to cause emphysema and lung cancer. NO_X contributes to ground level ozone, which irritates and damages the lungs.
Water Quality	SO_2 causes acid rain, which is harmful to plants and to animals that live in water, and it causes or worsens respiratory illnesses and heart diseases, particularly in children and the elderly. Heavy metals such as mercury can be hazardous to human and animal health.
Climate Change	Carbon dioxide is a greenhouse gas and a source of global warming.

Suggested Class Reading: *Dr. Seuss' The Lorax* – theme of pollution by industry

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ActivityE2a Light Bulb Worksheet

Objectives: Students will...

- Review energy information by creating and playing a game.

Time: 45 minutes
Location: Classroom

Materials:

- Light Bulb Worksheets
- Memory Card blank templates
- Markers
- Scissors

Discussion: What is electricity? How is it made? How do we use it? Use the Light Bulb Worksheet to explain how electricity gets to us. Draw a light bulb on the board and ask students where the electricity comes from for the light. Work backwards drawing each step on the board. 1. Light Bulb 2. Light Switch 3. Power Lines 4. Power Plant 5. Coal. Have students follow along and make the drawings on their worksheets. Show a photo of a smokestack so students may see how air is being polluted.

1. Give each student a card template worksheet and a few markers or crayons.

2. Poll the class to see who has played the game Memory. Have one student explain how it is played, then tell the class that they will make and play their own memory game about energy.

3. Each student should draw a picture about energy, using any of the information they have learned so far (power plant, the Lorax, light bulb, etc.). They must draw the same picture twice – once in each box.

4. Once they have completed their drawings, students may cut out their pictures along the perforated lines.

5. Take all of the student cards and find a space large enough for everyone to play OR divide the class into small groups and have each group play a round of energy memory.

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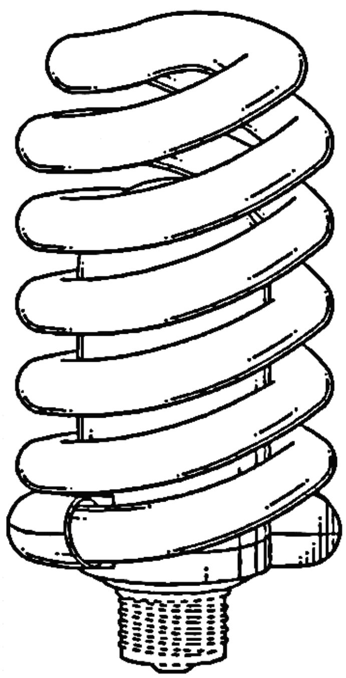
ActivityE2a Light Bulb Worksheet



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ActivityE2a Light Bulb Worksheet

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Activity E2b Power Plant Hook Up

Objectives: Students will...

- Learn how a power plant works using an interactive game.

Time: 20 Minutes
Location: Classroom

Materials: Power Plant Hook Up Cards

Discussion: What is electricity and how is it created? What are fossil fuels? How does it affect the environment and our health? What is climate change? The basic ideas are that creating energy pollutes the environment and the pollution has negative effects on human health and the environment.

1. Divide class into groups of 4-5 students. Give each group one set of Power Plant Hook Up cards.

2. Explain that they must study the cards and put them in order. You may give them the first (picture of coal) and/or last (picture of a CFL bulb) cards to get them started. How does energy get from this piece of coal to a light bulb?

3. Once all groups have arranged their cards, look at their arrangements and go over how a power plant works with the class.

Card #1 Coal

Card #2 Furnace – Coal, or another form of fossil fuel is placed in the furnace and burned.

Card #3 Boiler – The furnace heats water in the boiler, which is like a giant tea kettle, and creates steam.

Card #4 Turbine – The high-pressure steams spins the turbine.

Card #5 Generator – The turbine spins the generator, which contains copper wire and electro magnets. When these things rotate against each other, electricity is created.

Card #6 Power Lines – Power lines carry the electricity from the power plant to places where the electricity is used.

Card #7 Light Bulb – When you flip the switch in your house, this electricity turns on your light bulb.

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V

Fossil Fuel

A source of fuel that contains energy - coal, petroleum, or natural gas. It is found deep within the Earth and mined (dug out) or drilled. Once the fuel is extracted, it is brought to a power plant, where it is burned to release its energy.

ActivityE2b Power Plant Hook Up

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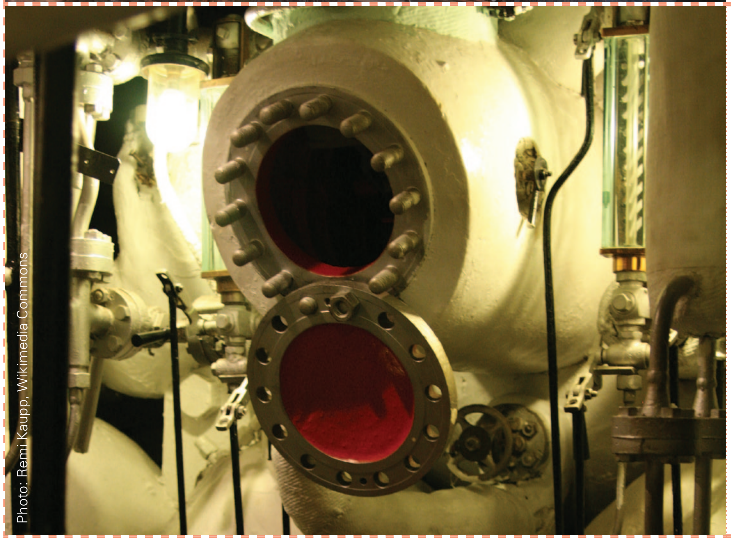
Furnace

A furnace is a piece of machinery that produces heat by burning materials that contain energy. When these materials are burned, they release heat. The heat is then used in another part of the power plant. To determine which step a furnace is, think about the way we might keep a fire burning and how we might use the heat produced by fire.



Boiler

A boiler is similar to a giant pot or teakettle. It turns water into steam. A power plant uses the energy from another step to create this steam.

Turbine

A turbine is made up of many blades that spin when steam is pushed through it. As the turbine spins, it is connected to another piece of machinery that also spins and produces electricity.

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ActivityE2b Power Plant Hook Up

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Generator

A generator is composed of a large magnet surrounded by copper wire. As the generator spins, it produces electricity. To determine which step a generator is, think about what might make it spin.

Power Lines

Power lines conduct, or carry, electricity from where it is produced to where it is used.

Light Bulb

Light bulbs use electricity to produce light in homes, schools, stores and many other places. To save electricity, make sure to turn off the lights when you leave a room!

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Lesson E3 Kilo- Whaaat?! Measuring and Saving Energy

How Do We Measure Energy?

Electricity is measured in *watts*, a unit of power. It was named for James Watt, the inventor of the steam engine.

To calculate the wattage of an appliance - how much electricity it needs to work – we must find its *voltage* **(V)** and *amperage* **(A)**.

Voltage is the rate at which energy is flowing. It is measured in volts.

Amperage or current is the amount or flow of energy. It is measured in amperes, or amps for short.

If you compare the flow of electricity to plumbing pipes, voltage would be the water pressure and amperage would be the flow rate. Now imagine turning on the shower. You can increase the power of the water hitting the tub in two ways: by increasing the water pressure or by increasing the amount of water coming out of the showerhead. Either way, the power is increased.

We find the wattage of an appliance by multiplying the voltage and the amperage.

Power (watts) = **Voltage** (V) x **Amps** (A)

For example, 4.5 V x 3 A = 13.5 Watts
(that's like a lamp, or small electronic device)

Now that we have power, we need to consider the unit of time! How long is the electricity being used? Energy = power x time. This is measured in kilowatt-hours (kWh).

For example, 300 watts x 5 hours = 1500 Watt-hours or 1.5 kWh

Wait kW? If we have more than 1000 watts, we can use the unit kilowatt, which is equal to 1000 watts. For instance, 3000 W = 3 kW

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Lesson E3 Kilo- Whaaat?! Measuring and Saving Energy

The following chart provides energy use and energy cost of small appliances.

Electricity Consumption Values for Typical Appliances

Appliance	Time in use	Kilowatt/hours used per year	Cost per Year
Aquarium	24 hours/day	700	$52.50
Clock	24 hours/day	36	$2.70
Clock radio	24 hours/day	44	$3.30
Coffee maker	30 minute/day	128	$9.60
Computer	4 hours/day	520	$39.00
Dehumidifier	12 hours/day	700	$52.50
Box Fan	4 hrs/day, 180 days/yr	144	$10.80
Microwave oven	2 hours/week	89	$6.68
Radio	2 hours/day	73	$5.48
Refrigerator	24 hours/day	683	$51.23
Television	3 hours/day	264	$19.80
Toaster oven	1 hour/day	73	$5.48

(Source: EIA)

Energy Conservation

Why is energy efficiency so important? The way we produce and consume energy has serious consequences for our health and the health of the environment. According to the EPA, the burning of fossil fuels over the past 200 years has caused a dramatic increase in heat-trapping greenhouse gases – especially carbon dioxide – in our atmosphere. As we create more greenhouse gases, more heat is trapped in our atmosphere, raising the surface temperature of the planet.

Temperature change may not seem like a big deal, but as the temperature of our entire planet rises, whole ecosystems will be drastically affected. The way we live will change. Scientists predict this change will lead to a rise in sea levels. As they rise, more land goes underwater, which will change where people can live and build homes. As we lose land, less space for people to live means that some areas may become more populated than they are now.

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Lesson E3 Kilo- Whaaat?! Measuring and Saving Energy

Changing temperatures influence weather patterns. This in turn affects things like how we produce food, or how easy or difficult it is for us to raise a family and maintain our communities.

A rise in temperature also means that some places will have more water and some places will have less. Places that currently have little water will lose even more to evaporation as the planet warms. In places with permafrost or glaciers, ice will melt at faster rates, producing more water, which could lead to flooding. Many organisms, including humans, are adapted to live in the climate we have now. If temperatures and weather patterns continue to change, we may be forced to make big and possibly unpleasant changes to the way we live in order to survive.

But wait, there's hope! And it can start in your school.

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Activity E3a Energy Detectives

Objectives: Students will...

- Investigate energy use around the school.

Time: 40 minutes
Location: Classroom, School

Materials:

- Energy Detective Badges
- Safety pins
- Markers

Discussion: Why is it important to save energy? What are ways that we can save energy?

1. Give each student an Energy Detective Badge template. Tell the class that they will be going on an important mission today – finding things in the school that use electricity.

2. Since the class will be walking through the school while other classes are in session, it may be helpful to have the class develop a series of hand signals to communicate. For example, you can use one hand signal for an appliance that uses a lot of electricity and another signal for an appliance that uses little electricity.

3. Once the students have designed and cut out their badges, affix them to their shirts using safety pins. Ask the detectives to look around the classroom and point out anything that is using energy right now.

4. As you walk around point out things that they might not immediately notice. (i.e. copier, etc.). When you return to the classroom, ask students if they saw any electricity being wasted. As energy detectives, they can now be more aware of when we are wasting energy.

ActivityE3b Kilowatt Matchup Game

Objectives: Students will...

- Understand the amounts of energy used by different appliances.

Time: 40 minutes
Location: Classroom

Materials: Kilowatt Matchup Game cards

Discussion: How do we measure electricity?

1. Divide class into small groups of 3-4.
2. Give each group a set of Wattage Game cards.
3. Have students match the appliance with the amount of electricity it uses.
4. Once all the groups have completed matching the cards, review the correct matches. Write them on the board as reference for the next activity.

A few points to consider for discussion:
These measurements are not exact. For example, some air conditioners can use quite a bit more or quite a bit less than 800 Watts, depending on the size, energy efficiency, etc.

Appliances that are related to temperature – they become really hot or keep things cold – use much greater amounts of electricity than other appliances. Examples include hair dryer, toaster oven, iron, fridge, AC, and microwave.

When considering how much energy an appliance consumes, we measure the wattage, but important to think about the amount of time the appliance is in use. For example, a microwave may use 1000 Watts, but we only use it for 2-3 minutes at a time, whereas a 100-watt television could be on for 8 hours.

Correct Matches:
Camera -25 Watts
Light Bulb - 60 Watts
Television - 100 Watts
Computer (Desktop) - 200 Watts
Refrigerator - 750 Watts
Air Conditioner - 800 Watts
Microwave - 1000 Watts

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25 Watts

ActivityE3b Kilowatt Matchup Game

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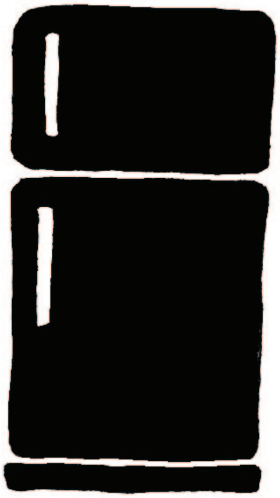
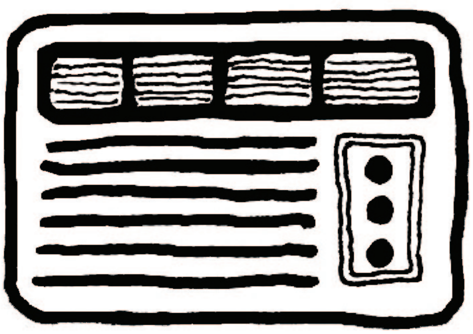
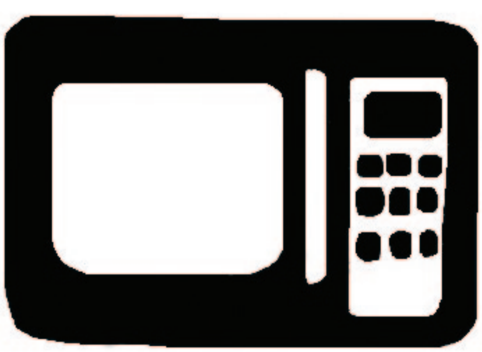
	**750 Watts**
	**800 Watts**
	**1000 Watts**

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ActivityE3b Kilowatt Matchup Game

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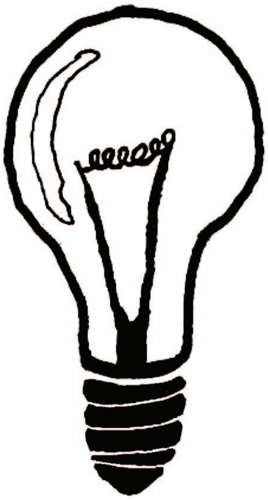
V



60 Watts

100 Watts

200 Watts

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ActivityE3c Classroom Energy Audit

Objectives: Students will...

- Understand how to measure electricity in small appliances.
- Understand energy use in their classroom.
- Form hypotheses based on collected data, of the energy use of various appliances.

Time: 50 minutes
Location: Classroom

Materials: Kill-A-Watt™ meters

1. Ask class to name all of the things in the classroom that use electricity. Write down their answers on the board.
   NOTE: Stick to things that have outlets or you will not be able to measure the lighting system with the Kill-A-Watt™ meter.

2. Refer students to the wattage game answers. Ask students to use these numbers as a guide to hypothesize how much electricity each classroom appliance uses. Write down their answers on the board next to the respective appliance.

3. Demonstrate how the Kill-A-Watt™ meter works.
   a. Unplug the appliance to be tested.
   b. Plug the Kill-A-Watt™ meter into the outlet (make sure that the meter is set to kW – just press the button marked "kW" until it appears on the screen
   c. Now plug the appliance into the Kill-A-Watt™ meter and note the reading (for things such as an electric pencil sharpener or a CD player, the reading may be different if the appliance is not performing. Students should measure appliance both ways.

4. Divide the class into small groups of 3-4 and give each group a kill-a-watt meter. You may either assign each group to measure one appliance or have all groups rotate through all the appliances.

5. After the class has completed taking measurements, ask students to come back and report their findings. Record their answers on the board next to their initial hypotheses. How do the actual numbers compare to what they originally thought?

Extension for 4th and 5th grades: Boiler Tour

The boiler is a fascinating yet often unknown part of the school. Talk to your custodian about arranging a boiler tour for your class. The custodian can explain how the school's heating system works and how much energy the school consumes. Have students develop questions about your school and energy before the tour.

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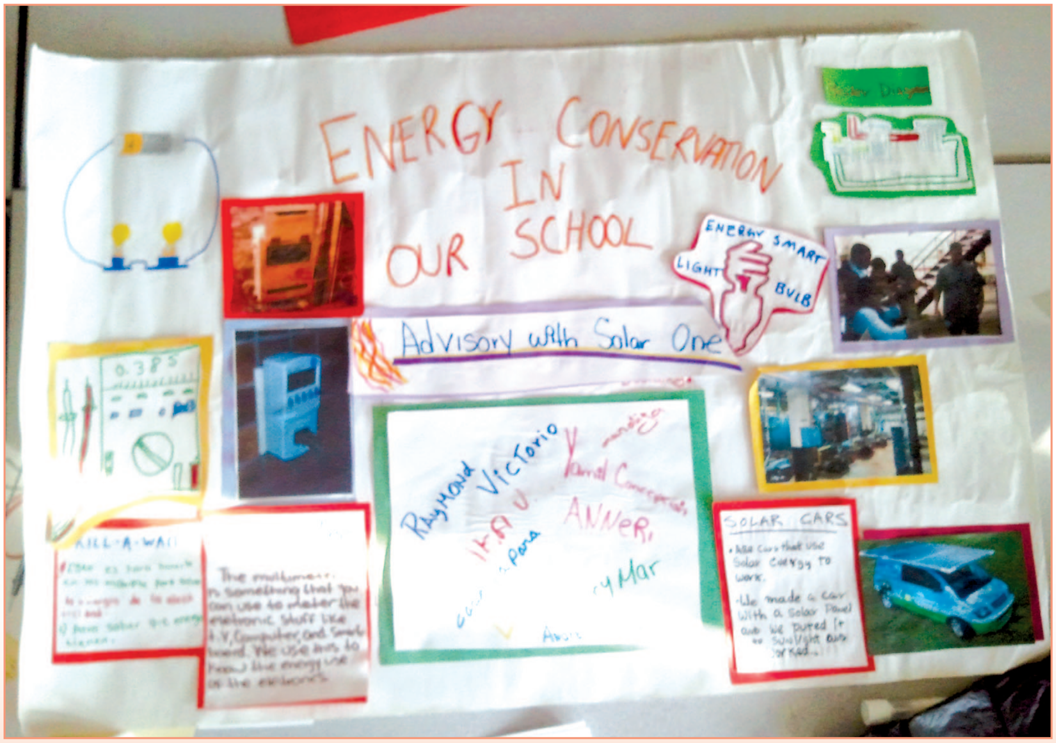
Lesson E4 Energy Awareness Campaign

Energy efficiency is one strategy we can use to save energy in your school. This strategy may take many forms, but primarily aims to reduce electricity and heating fuel usage. Efficiency measures can be small, but significant! Start with simple things like making sure lights are turned off and unplugging unused electronics. Replace outdated appliances with Energy Star-certified (energy efficient) ones. Plan ahead by using timers and occupancy sensors. Most importantly, encourage student led initiatives that get the entire school community involved in saving energy.



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Activity E4a Turn Off the Lights!

Objectives: Students will...

- Create visual materials to promote energy awareness and conservation throughout the school.

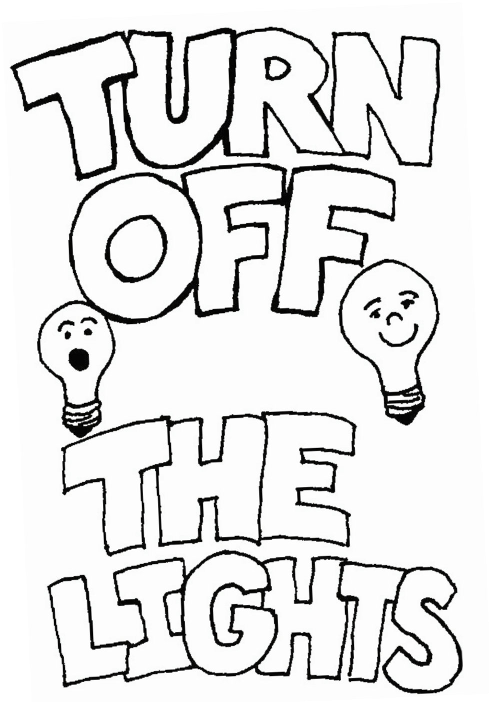
Time: 1 hour
Location: Classroom, School

Materials:

- Turn Off the Lights sticker templates
- Markers
- Crayons
- Scissors

Discussion: How can we encourage everyone at school to save energy?

1. Give each student 1-2 stickers templates and crayons or markers.
2. Students should color in and decorate their templates, cutting them out if necessary.
3. Once everyone has completed decorating their stickers, ask the class to think about what they saw around the school when they went out as Energy Detectives. Where are a few good places to put stickers reminding people to save energy? Make a list of their responses.
4. Go to the locations listed on the board as a class, and place stickers by light switches, outlets, etc.



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ActivityE4b Energy Awareness Campaign

Objectives: Students will...

- Develop an energy awareness campaign directed at the school and/or local community in an effort to reduce energy use.
- Raise public awareness as to the impacts of energy production and use.

Time: 2-3 days development, ongoing project
Location: classroom, school, but may also be in the auditorium, community, etc.

Materials:

- TBD – paper, markers, poster board, and possibly larger craft items, cameras, etc.

Discussion: You are the energy experts for your school. Using the information you collected in the classroom energy audit, come together and discuss your findings. What needs improvement? How can this be done? What can students, staff, and community members do to reduce the school's energy use?

1. As a group, develop at least 3-5 solid ideas of ways for students, and staff to reduce energy use in the school. Write them down on chart paper. Use the following list of energy saving tips for schools (Source: New York City's Department of Citywide Administrative Services Division of Energy Management):

All year - General

- Shut down computers and other electronic equipment such as copiers or fax machines at the end of the day. When you are away from your desk for extended periods during the day, turn off the monitor.
- Unplug personal electronics such as coffee makers and cell phone chargers when not in use. Even just the digital clock on a small coffee maker consumes energy and increases the building's "plug load."
- For grades K-6, suggest that teachers elect a light monitor to ensure that classroom lights are shut off at the end of the day and anytime the classroom is unoccupied.
- Turn off overhead lights in areas where daylight is sufficient or desk lighting is available, or when room is unoccupied.
- At night, turn off all facility lights not required for security.

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Activity E4b Energy Awareness Campaign

Winter - General

- Thermostats should be set to 68 F degrees during cold weather months. On very cold days, the City Health Code allows a maximum daytime temperature of 72 F degrees at schools and day care centers.
- Keep radiators and heating vents in classrooms and offices free from dust and obstructions. Keep books and other supplies or materials off radiators, and do not place furniture or other objects in front of heating vents.
- Open blinds, shades, and drapes during daylight hours to take advantage of the natural heat and light provided by the sun. Shut the blinds or shades at the end of the day to retain the room's warmth at night.
- Arrange desks, chairs, and work stations away from windows and outside walls to avoid drafts.
- Check that window air conditioners are properly sealed, and instruct teachers to notify the school's custodian if they seem to be leaking cold air.

2. Now it is your job to inform the public. Create an energy awareness campaign. As a class, brainstorm the most effective ways to do this. Below are some examples to help get you started:

   - **Green Dashboard –** Create a bulletin board in a public area of the school (lobby, hallway, etc.) in which you outline the school's previous energy consumption, goals for the future, and what efforts are currently being made to reduce energy. This keeps the public informed about your project as well as the school's progress.
   - **Signage –** This can be anything from informative posters to stickers on light switches reminding people to turn them off to brochures, etc.
   - **Public or School-wide Assemblies –** Put together a presentation about energy use, its impacts and your findings in the school. Show it to the public and have discussions about how people can help.
   - **Media –** Use local TV and radio to promote your efforts in the school. If you have access to a camera, make a video about what students are doing and show it in schools, churches, community board meetings, etc.
   - **Green Classroom Competitions –** Get students involved by making it competitive. Which classroom can be the greenest? Which classroom can have the biggest impact on energy reduction?

3. Once you have developed your approach, assign tasks. Everyone on the class should be a part of the process. Perhaps a few students enjoy drawing. They should work on signage. Other students like to perform in front of others, in which case, they should work on public outreach and presentations. A campaign has a job for everyone!

4. **Follow Up –** Depending on what your class has developed, the actual delivery of your campaign could be a short or long-term project. It is important to continue to monitor energy use throughout and after the campaign.

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Lesson E5 Zoom Spark... Exploring Electricity!

Movin' on Down the Line –Circuits

Electricity travels in closed loops, or circuits. It must have a complete path before the electrons can move. The electrons cannot move if a circuit is open. When we flip on a light switch, we close a circuit. The electricity flows from a wire, through the light bulb, and back out another wire. When we flip the switch off, we open the circuit and no electricity flows through the light.

Batteries

We use many different types of batteries for a wide array of purposes. Flashlights, cellular phones, cars, and buildings use batteries. Each battery is made differently, but the way they work is the same. A battery is stored chemical energy that is converted into electrical energy using two different metals in a chemical solution. A chemical reaction between the metals and the chemicals frees more electrons in one metal than in the other. One end of the battery is attached to one of the metals; the other end is attached to the other metal.

The end of the battery that frees more electrons develops a positive charge, and the other end develops a negative charge. If a wire is attached from one end of the battery to the other, electrons flow through the wire to balance the charge. If a light bulb is then placed along the wire, the electricity can flow through the bulb. Electrons flow from the negative end of the battery through the wire to the light bulb. The electricity flows through the wire in the light bulb and back to the positive end of the battery, creating a simple circuit.

Americans use an average 8 batteries per person each year.

Discarded batteries produce most of the heavy metals - substances like lead, arsenic, zinc, cadmium, copper, and mercury - found in household trash. These metals are toxic and can be harmful to humans and wildlife. The dead batteries wind up in landfills, where these heavy metals can seep into the ground water and eventually into the food chain.

What can you do?

- Turn off battery-powered items when not in use.
- Forty percent of all battery sales are made during the holiday season. Buy or ask for gifts that do not require batteries.
- Use rechargeable batteries.
- Remove the batteries when you don't expect to use the item within 2 months.

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ActivityE5a Battery Worksheet

Objectives: **Students will...**

- Understand that batteries produce electricity and will identify items that use batteries.

Time: 45 minutes
Location: Classroom

Materials:

- Battery Worksheet
- Crayons
- Markers

Discussion: What are things that use batteries? Does a battery produce electricity? How does it work?

1. Ask the class to name items they use that require batteries.

2. Pass out crayons/ markers and worksheets.

3. Have the students color in the objects that use batteries.

4. They can circle the objects that use plugs.

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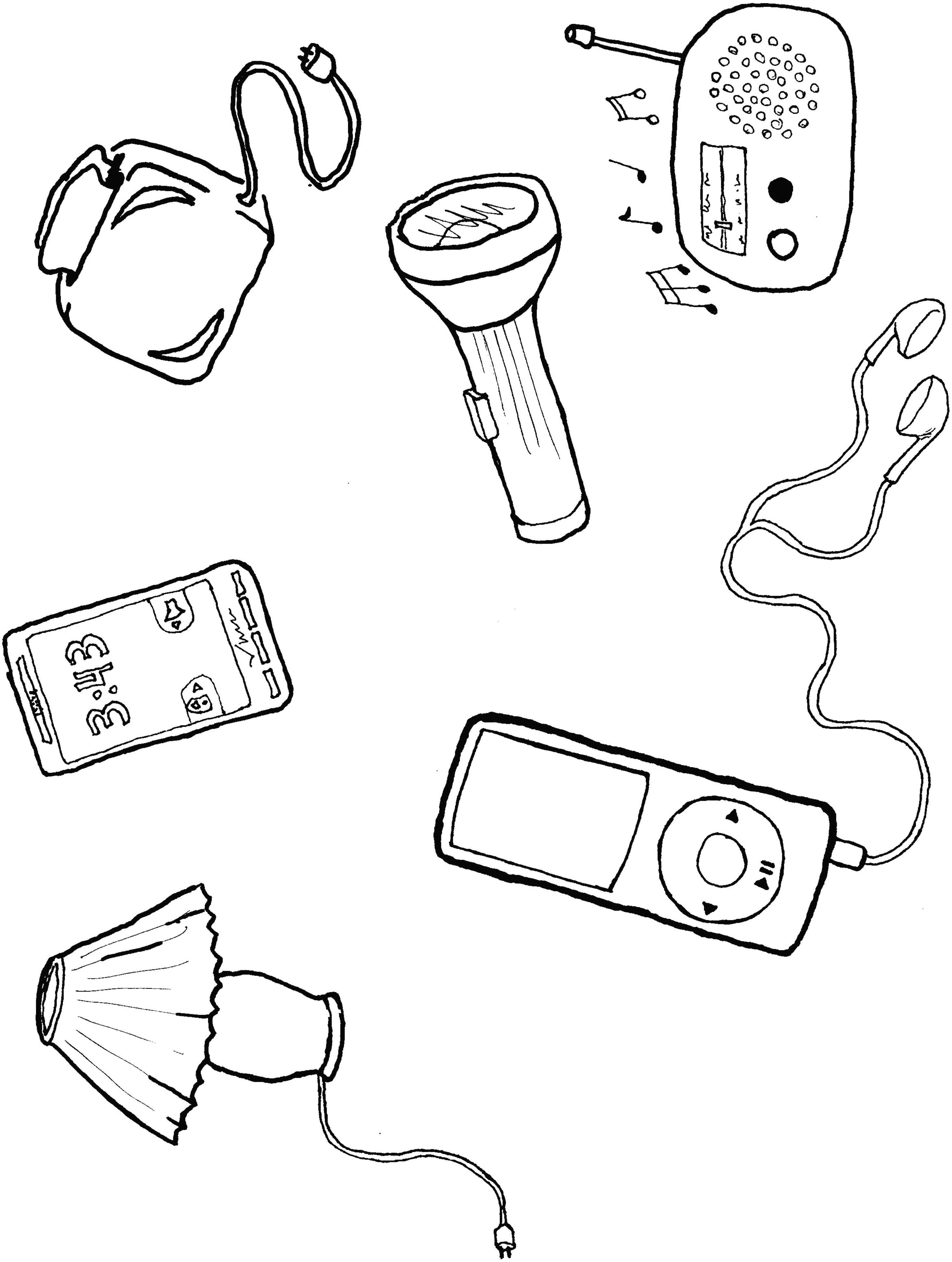

ActivityE5b Creating Circuits

Objectives: Students will...

- Experiment with measuring electricity and learn to read a multimeter.
- Create a simple circuit.

Time: 90 minutes
Location: Classroom

Materials:

- Paper
- Pencil
- Multimeters
- 9-volt batteries
- Citrus fruit **(e.g., lemon, lime, orange)**
- Copper nails
- Screws or wire **(about 2″ long)**
- Zinc nails or screws or galvanized nails **(about 2″ long)**
- Holiday lights or LED lights with 2″ leads **(enough wire to connect it to the battery and nails)**

Discussion: What is a battery? Stored energy (chemical energy). How does a battery work? What is a circuit?

1. Divide the class into groups of 2-3 students and introduce the multi-meter tool. A *multimeter* is a simple tool used to measure electricity.

2. Have students practice using the positive and negative ends of the meter and taking readings. You may want to select one unit of measurement – volts, for example,- for students to use.

3. Ask each group to use their multi-meters to measure various surfaces around the classroom. Do they note any changes in the multimeter readings? Touching conductive surfaces like metal may show as a slight surge in voltage on the multimeter.

Students will measure the stored energy in a battery and a citrus fruit (i.e. lemon, orange). Then using wire, a battery and a few other materials, they will create a simple circuit and convert stored energy into electrical energy. A *circuit* is any device that provides a path for an electrical current to flow.

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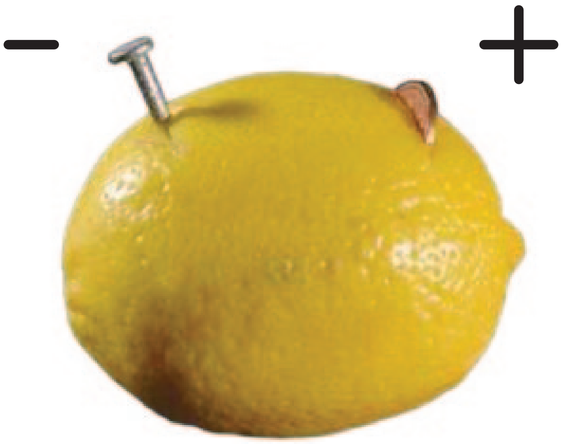
Activity E5b Creating Circuits

Citrus



1. Give one citrus fruit and a copper penny and zinc nail to each group.

2. Each group should roll the fruit around on the table or gently squeeze it with their hands so that the juice flows freely, but without breaking the skin.

3. Insert a zinc nail and a copper nail (or copper penny) into the fruit so that they are about 2″ apart. They should not touch each other. Avoid puncturing through the other side of the fruit. The zinc nail and the copper penny are electrodes. The orange juice is an electrolyte.

4. Using the multimeter, attach alligator clips to the positive and negative ends of the leads. Attach the clips on the other ends to the nails and/or penny. The positive lead should go to the copper and negative to the zinc. Students should observe and record the reading on the multimeters.

Battery

5. Give each group a nine volt battery and a holiday light. Ask students to measure the stored energy in the battery by using the alligator clips to attach the multimeter to the nodes on top of a 9-volt battery and observe their readings.

6. Roughly an inch of insulation should be removed from the leads of the holiday light, so that the leads may be wrapped around the nodes on the battery.

7. Once the second lead is connected, the light will turn on!

8. Each group should measure the output of the circuit using the multimeter. After recording their findings, have a brief discussion about the various results. If time permits, students may hypothesize whether or not the citrus contains enough energy to power the light. They may test their hypotheses by connecting the light leads to the zinc and copper nails.

What did you measure?	Voltage (Volts)	Amperage (Amps)	Power (Watts)
Battery			
Orange			
Circuit			

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ActivityE5c Magnet Motors

Objectives: Students will...

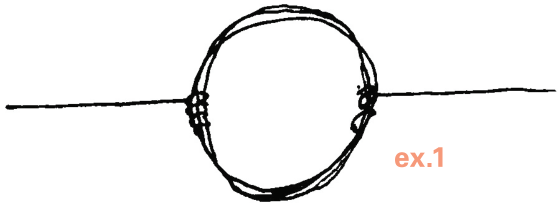
- Construct a simple DC motor

Time: 45 minutes
Location: Classroom

Materials:

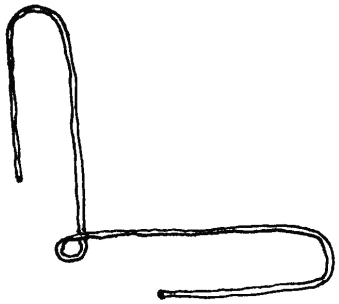
- C or D batteries
- 2-3″ Ceramic magnets
- Large paper clips
- Thin-gauge enamel coated copper wire
- Tape
- Sandpaper

1. Divide class into small groups of 2-3 students each.
2. Give each group one battery, one magnet, 2 large paper clips, a small piece of sandpaper and 20 inches of wire.
3. Wrap the wire around the battery a few times to create a coil. Leave some wire sticking out on opposite ends of the coil. (ex.1)



ex.1

4. Use the sand paper to remove the coating on the straight pieces of wire.
5. Bend paper clips into L-shapes (ex.2) and tape them to the sides of the battery



ex.2

6. Put the magnet on the side of the battery and put the straight pieces of your wire into the loops formed by the paper clips so that the coil is sitting over the battery.
7. Make sure the coil is level and can spin without hitting the battery.
8. You may adjust the position of the magnets to affect the spinning of the coil. Be certain that students note the heat generated by this activity.

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Lesson E6 Renewable Energy: Keep It Mean, Green, and Clean

Sources of energy that can be naturally replenished are renewable forms of energy such as sunlight, wind, water, and geothermal heat. Renewable energy sources are either infinite (the sun, wind and water) or constantly renewing. In 2006, about 18% of global energy consumption came from renewable energy.

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ActivityE6a Renewable Energy Coloring Book

Objectives: Students will...

- Identify different sources of renewable energy.

Time: 30 minutes
Location: Classroom

Materials:

- Renewable Energy Coloring Book
- Markers
- Crayons

Discussion: Renewable energy. What is it? Why is it good? What are the types of renewable energy?

1. Give each student the coloring book and at each page ask them to identify the energy on that page.

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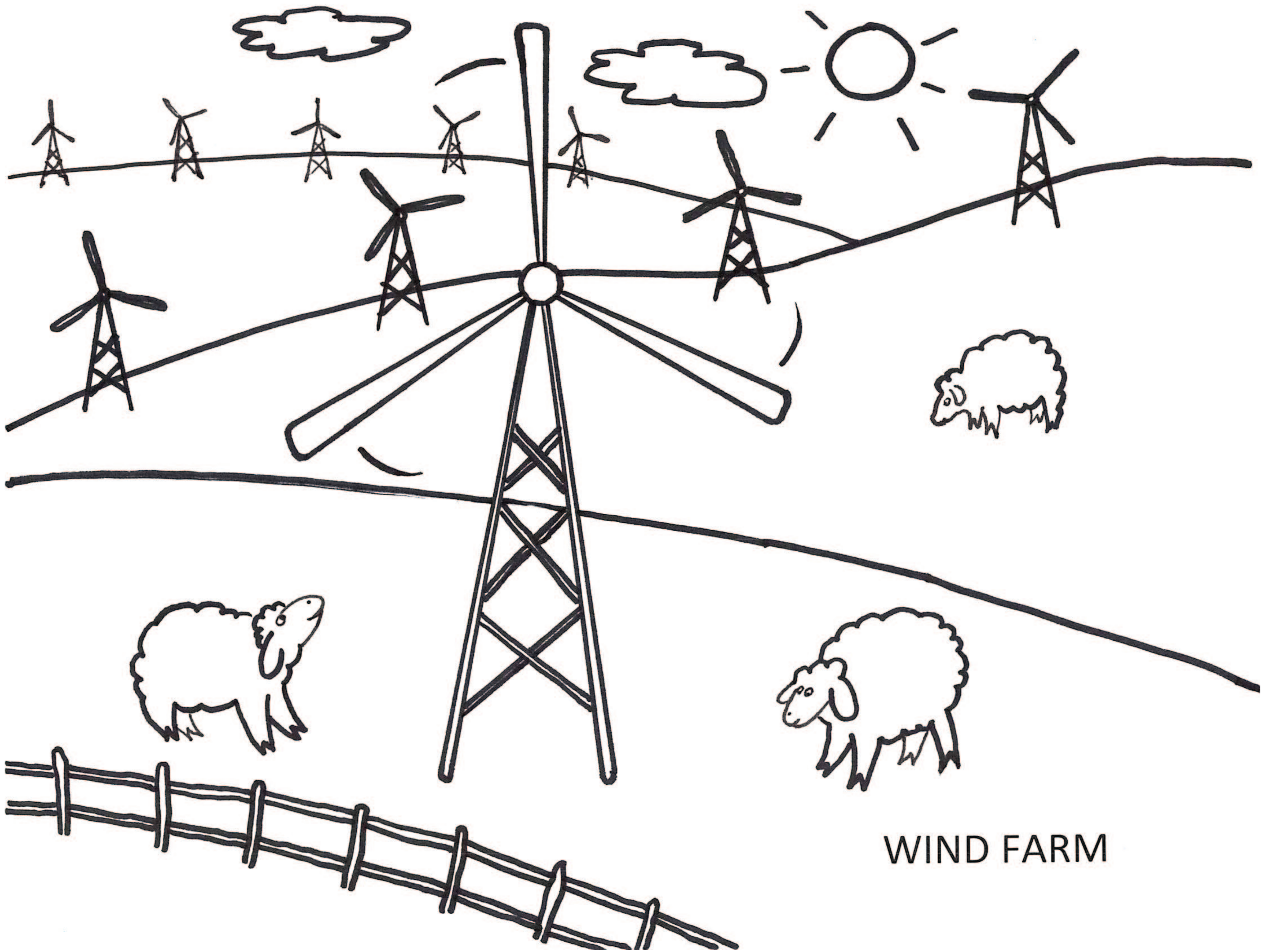
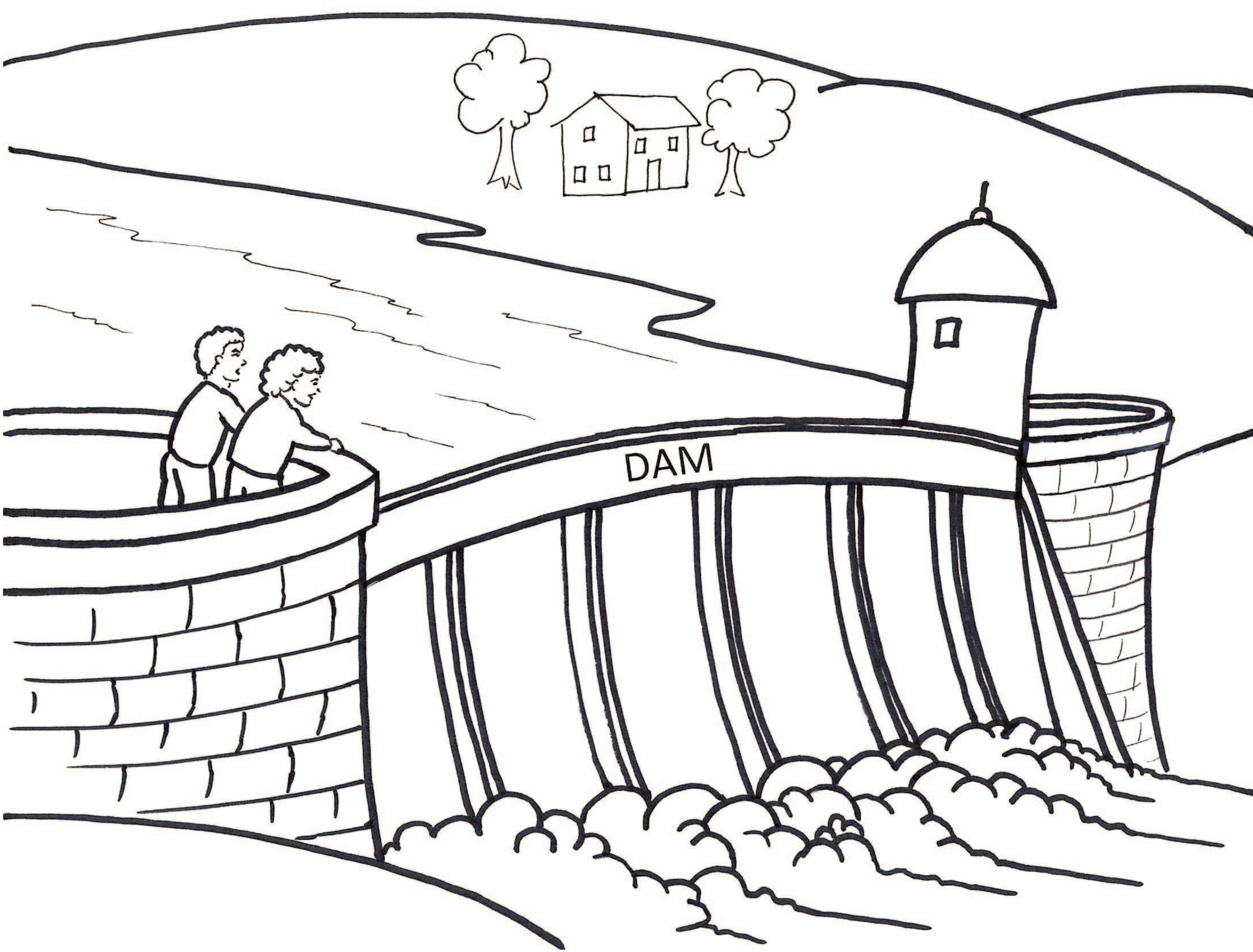
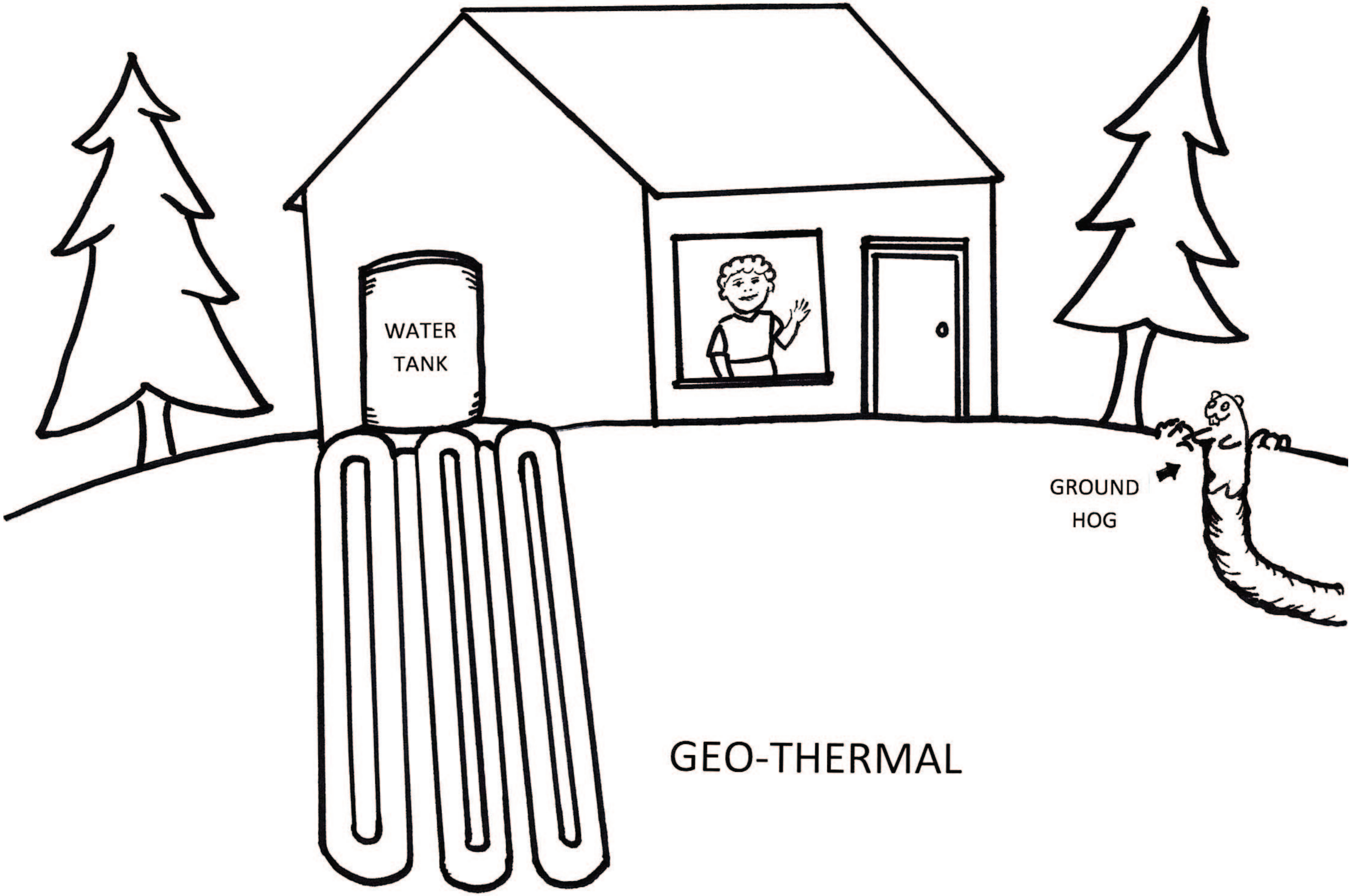
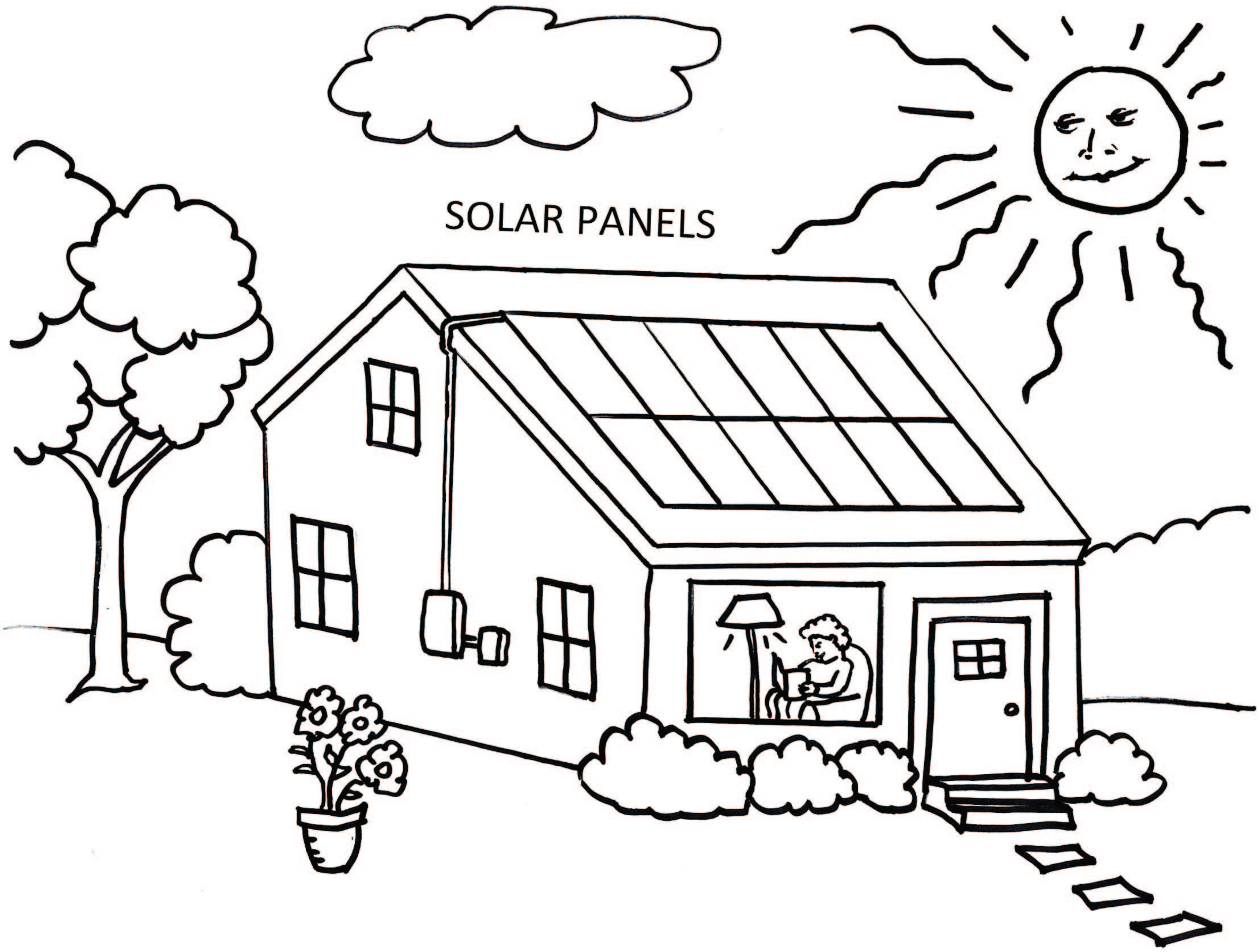


WIND FARM


DAM



GEO-THERMAL


SOLAR PANELS

ActivityE6b Exploring Renewable Energy

Objectives: Students will...

- Understand and share information about various forms of renewable energy

Time: 40 minutes
Location: Classroom

Materials: Renewable Energy Worksheets

1. Divide class into four groups.

2. Give each group one of the renewable energy readers: Solar, Wind, Water, and Geothermal.

3. Each group should study the reader and make a presentation to the class. If time and resources permit, have each group research their renewable energy source further, using the internet, newspapers, etc. You may ask groups to research or consider the pros and possible cons of their energy source and research any local buildings or facilities using this energy source.

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ActivityE6b Exploring Renewable Energy

Worksheet 1: Solar

The sun is the Earth's largest energy source. Solar energy is energy from the sun. It has been used since ancient times for things like cooking, drying, heating bathwater and warming homes. The rays of sunlight that reach the Earth can be changed into other forms of energy like heat and electricity.

Solar energy can be converted into electricity in two ways: 1. Photovoltaics (PVs), also called *solar panels*, made from silicon, react to sunlight and convert it directly into electricity. Solar panels may be really small like a solar-powered calculator or big enough to power a house. They can be placed directly on the building or object that will use the electricity. This means that if you have solar panels on your house or school, you are making your own electricity. It does not come from a power plant.

Several solar panels working together as one system is called an *array*. Extremely large solar arrays may be located in big, open spaces to generate large amounts of electricity. This is called a solar farm.

Concentrating solar power plants use the sun's heat to heat a fluid which produces the steam that powers a generator. Does this sound familiar? The solar power plant is similar to a power plant that burns fossil fuels except that the sun does not pollute. California has the world's largest solar power plant.

Photovoltaics only produce electricity when the sun is out. In order to use solar energy at night or on days when there is no sun, the extra energy must be stored in a battery.

Solar energy is known as a renewable energy. It is a constant source of energy that is free. It is a clean energy source that does not pollute air, water or land and, unlike fossil fuels, it will not run out.

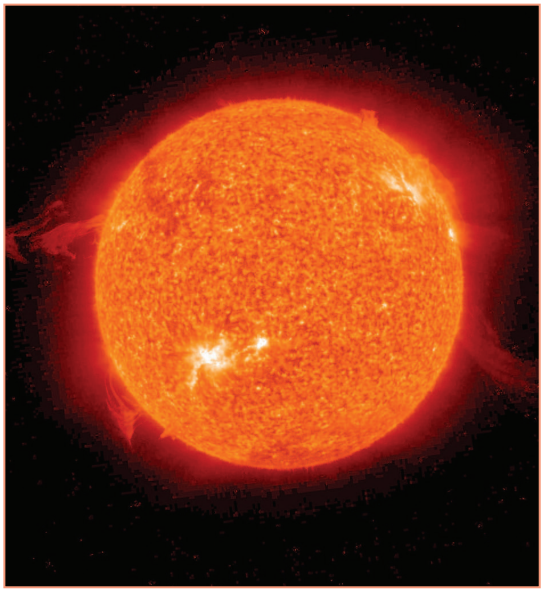

Photo: NASA/GSFC/SOHO

Photo: Dreamingof-dreamstime.com

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ActivityE6b Exploring Renewable Energy

Worksheet 2: Wind

For hundreds of years wind energy was used to power the windmills in Europe and Asia, converting the kinetic energy of the wind into mechanical energy. The wind turned wheels in the windmill to grind grain. Today wind energy is mostly used to create electricity.

Like windmills, today's wind turbines use rotating blades to collect the wind's energy. Wind turbine systems are made of a tower to support the wind generator. A drive shaft connects the blades to the generator. When the wind turns the blades, the generator produces electricity.

Wind turbines can be quite large – as tall as a 20-story building! When a lot of turbines are built in one place, it is called a wind farm. Wind farms must be built in areas where they will catch a lot of wind, such as flat open areas, near the sea, at sea. Wind energy makes up about 6 percent of renewable electricity generation in US. Texas has the world's largest wind farm and produces more wind power than any other U.S. state.

Photo: freeimages.co.uk

Photo: edupic.com

Green Design Lab™ © Solar One 2011

Worksheet 3: Water (Tidal Power and Hydroelectricity)

Hydroelectricity is the production of electricity using the motion of water. Most hydroelectric power comes from the potential energy of water that is held back by dams. The water falling into a spillway spins a turbine that fuels a generator, which produces electricity. In 2006, just under 20% of the world's electricity was supplied by hydroelectric dams and other systems. The Three Gorges Dam complex on the Yangtze River in Hubei, China, generates more hydroelectricity than any other dam in the world.

Tides in the ocean are caused by the gravitational pull of the sun and the moon, combined with the rotation of the Earth. Waves are created by wind blowing over the surface of the water. Wave power or tidal power uses the motion and energy created by these natural phenomena to generate electricity. Wave power farms are being used around the world to generate electricity off the coasts of countries like Scotland, Portugal and the United States.

Photo: US Army Corps of Engineers

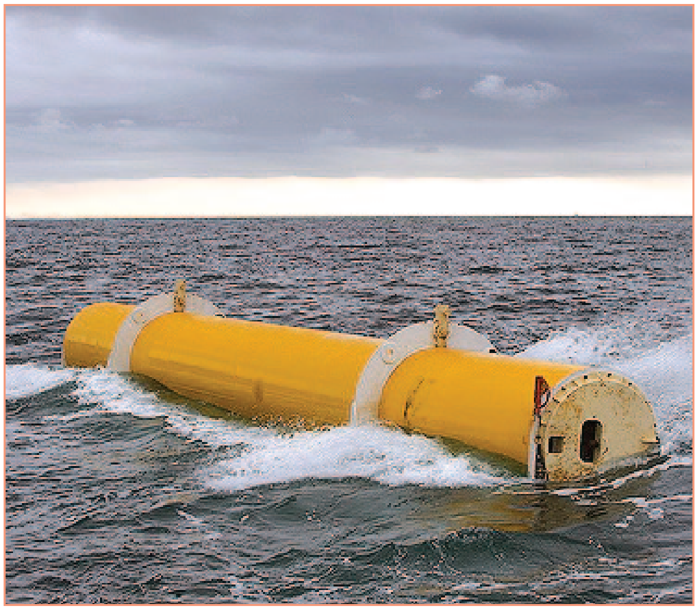

Photo: Aquamarine Power

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ActivityE6b Exploring Renewable Energy

Worksheet 4: Geothermal

“Geo” means “Earth” and “thermal” means “heat”. Geothermal power comes from heat stored in the Earth. Think about a volcano – this is geothermal energy in action. Over 70 countries make use of geothermal heating, consuming over 38 gigawatts (GW) of energy. There are many different ways that we use geothermal energy – for heating purposes and to produce electricity, for example.

How does the Earth heat things up? Even though the Earth’s surface can freeze in the winter and get warm in the summer, the ground below the surface stays at a constant temperature of about 57 degrees Fahrenheit. For every 328 feet underground, the temperature increases 5.4 degrees Fahrenheit. The most popular use is a piping system through which water or air is pumped. The circulating air or water transports this heat to the surface. It can be used to heat homes or drive industrial processes. Most geothermal energy in the United States is found in the western States and in Hawaii. Out of all 50 states, California generates the most electricity from geothermal energy.

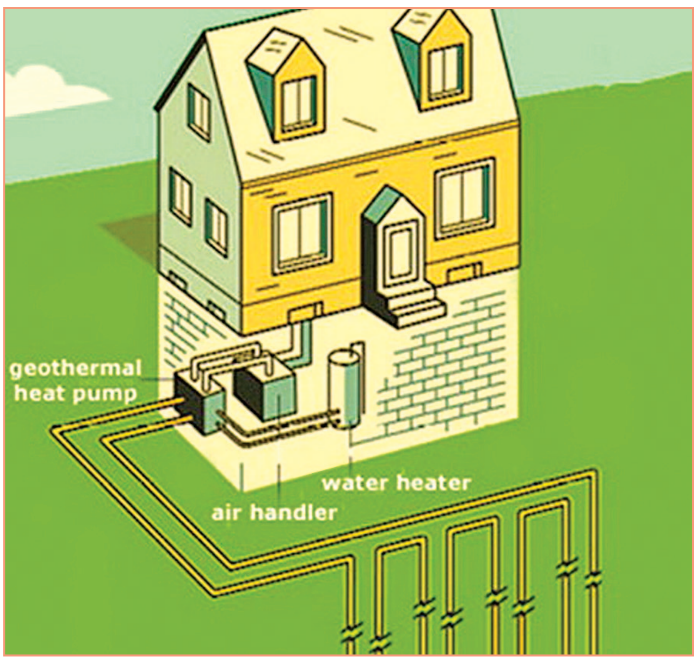

Photo: homeheatingsystems.org

Photo: Titan36 - Wikimedia

Notes.

Lesson E7 Wind Energy


Photo: Huw Williams, Wikimedia Commons

Wind is caused by changes in atmospheric pressure because the sun unevenly heats the Earth's surface. As air moves from areas of high pressure to areas of low pressure, wind is created.

Wind energy has been used for hundreds of years. Sailboats use wind as a way to move across the water. Windmills used wind to grind grains into flour or to pump water. Today's wind turbines are machines designed to capture the movement of wind to create electricity. A turbine is made of three blades attached to a drive shaft. Like a pinwheel, the wind blows the blades, forcing them to turn. The motion of the blades turns the driveshaft, which turns the turbine.

Using the energy of wind to create electricity does not burn fossil fuels and does not produce pollution. It is a renewable resource.

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Activity E7a Wind Energy Pinwheels

Objectives: Students will...

- Understand the mechanical energy of wind by creating pinwheels.

Time: 45 minutes
Location: Classroom , schoolyard

Materials:

- Pinwheel templates
- Markers
- Scissors
- Pencils with erasers on top
- Pushpins or thumbtacks

1. Ask the class if they remember how we make electricity. Refer them to power plants.
2. Show them a pinwheel and briefly explain how a wind turbine works (make connection to a wind mill). Does a windmill have smokestacks? Does a wind mill pollute? Is it free?
3. Pass out a pinwheel template and markers to each student. Students may color or decorate their pinwheels.
4. Once they have completed coloring the pinwheels, they may cut along the four lines on the template.
5. Using the pencil as the base or "tower," you and any other adults may go around the room helping students assemble the pinwheels.
6. To create the pinwheel: Center the cut paper on the eraser, gently pull (don't fold) every other corner to the center of the pinwheel. Pushing the thumbtack through all four points in the center and into the eraser.
7. Test pinwheels outside or using a fan indoors.

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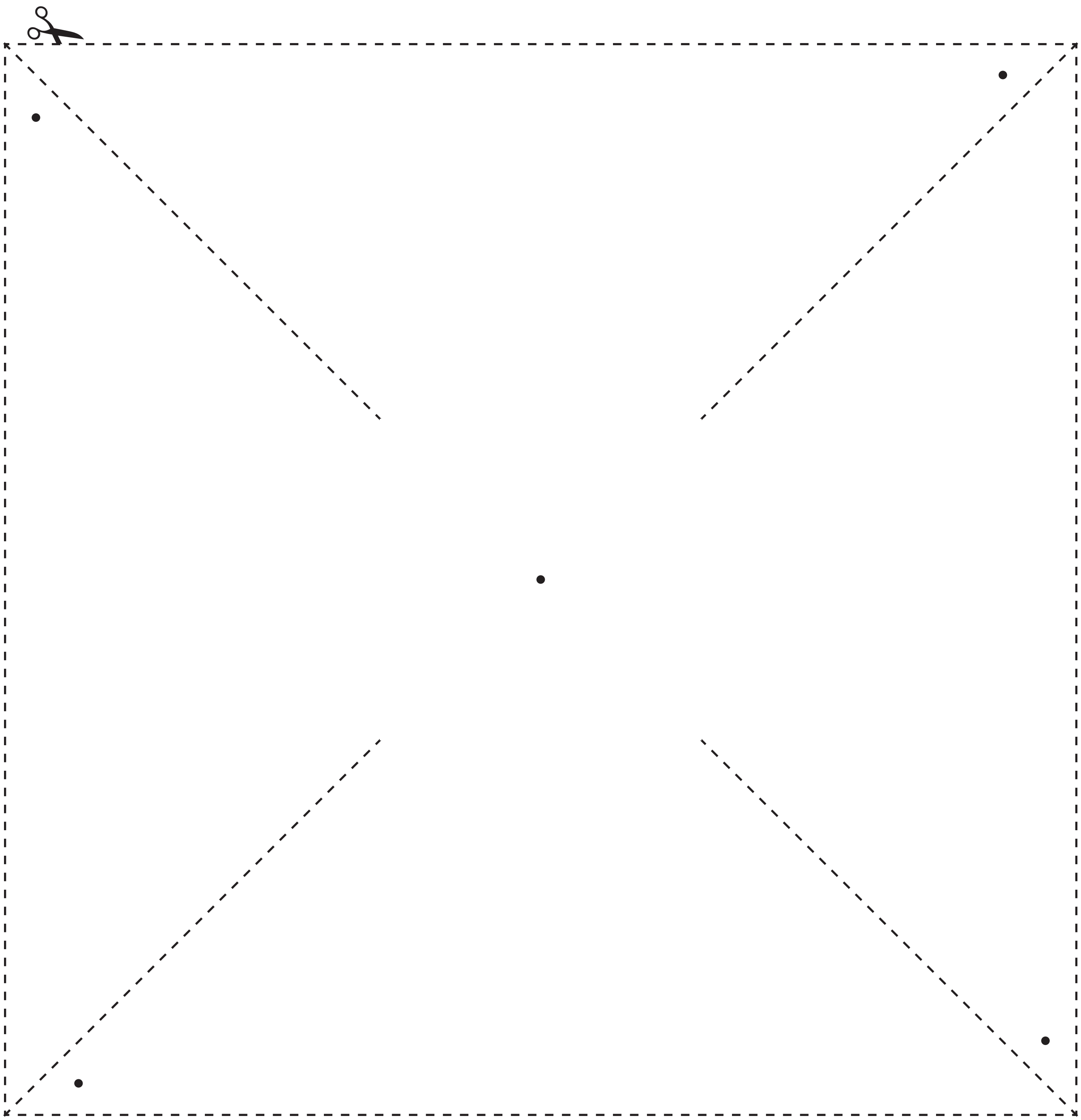
Activity E7a Wind Energy Pinwheels



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ActivityE7b Wind Turbines

Objectives: Students will...

- Experiment with energy output and efficiency of wind energy.

Time: 1-2 hours
Location: Classroom / schoolyard

Materials: Online resource for ordering wind turbine kits: KidWind - http://www.kidwind.org/

The KidWind website offers wind turbine kits accompanied by curriculum and extension activities. The turbine has an LED light attached to illustrate the electric output of the turbine. For this particular model, you need only one per class. The turbine contains demonstration blades and a crimping hub, which contains 12 holes and dowels.

Using the dowels, students design their own blades, testing them for efficiency and output. Factors to consider in the design of the blades are:

1. Length of blades
2. Number of blades
3. Angle of blades
4. Shape of blades

Directions for constructing horizontally oriented wind turbines out of recycled materials.

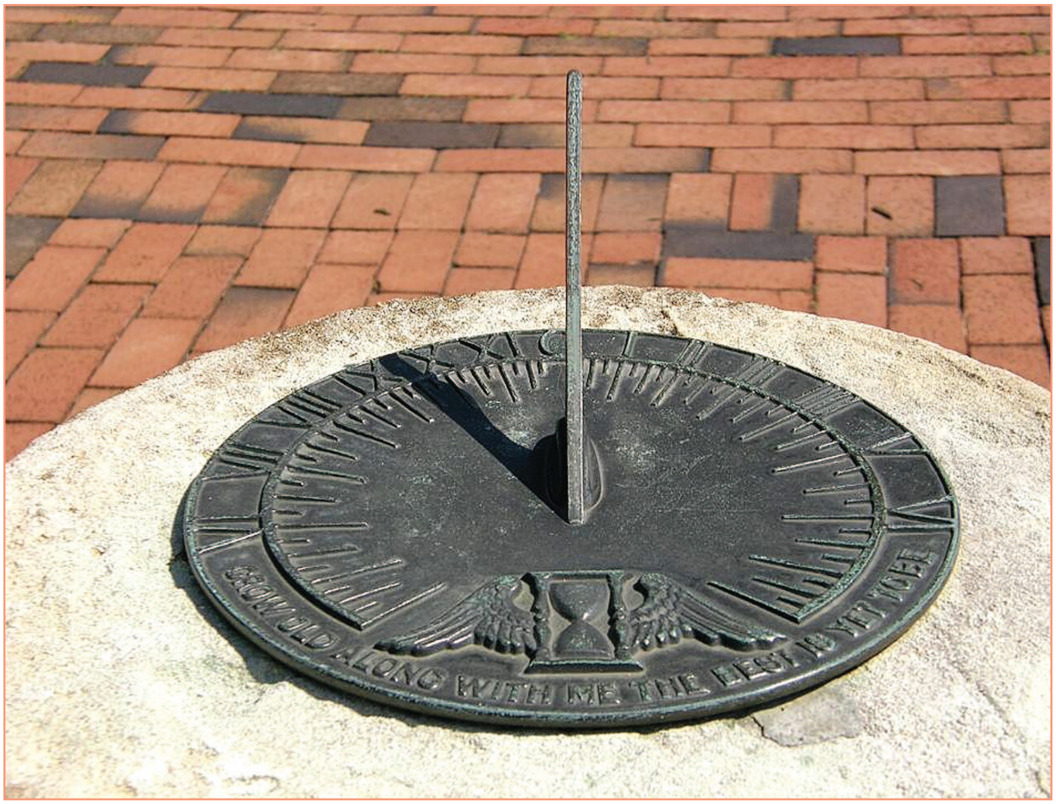
http://www.instructables.com/id/A-Paper-Plate-and-Pop-Bottle-Savonius-Wind-Turbine/

http://www.instructables.com/id/Cardboard-Savonius-turbine/

NOTE:
Unless a motor is attached to either of these turbines, you will not be able to measure the output with a multimeter, but they are very good projects for illustrating the concept of wind energy.

Lesson E8 Everyone Loves the Sunshine: Solar Energy

The sun is our greatest energy source: infinite, reliable, and readily available all over the world. Every hour the amount of sunlight that reaches the earth is greater than the amount of energy used by every person on the planet in an entire year. It takes sunlight only eight minutes to travel the 93 million miles from the sun to the Earth!



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Activity E8a Solar Beads

Objectives: Students will...

- experiment with solar beads to understand properties of sunlight

Time: 30-45 minutes
Location: Classroom, outside

Materials:

- UV protection sunglasses
- Sunscreen
- String
- Solar beads*

*Solar beads range in price from roughly $7-$27 depending on retailer and size of order. They may be ordered from numerous websites, including:

http://www.stevespangler-science.com/product/color-changing-uv-beads

http://www.scientificsonline.com/solar-beads.html

Discussion: Reflect on initial discussion about the sun. How can we use the sun's energy?

Solar beads are coated with a UV-reactive pigment so the beads change color in the presence of sunlight's UV rays. Students may investigate properties of sunlight in many ways. A few ideas include:

1. Students may make bracelets or string together a sun strip of beads to hang in a classroom window. They may test what happens to solar beads on a sunny day or a cloudy day.

2. Students may test the effectiveness of sunscreen by coating the beads with sunscreen and exposing the beads to sunlight.

3. Students may test different sunglasses by placing the beads behind UV-protection sunglasses and non-UV protected sunglasses.

4. If you are unable to go outside with your class, you may use a gro-light or black light in the classroom.

5. Prescription bottles block a surprising amount of UV-light. Students may test a variety of plastic containers to see how effective they are at blocking UV light.

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Activity E8b DIY Sun Dial Watches

Objectives: Students will...

- Understand one method of harnessing sun's energy by constructing sundials

Time: 30 minutes
Location: Classroom, outside

Materials:

- Watch face templates
- Markers
- Material for wristbands (you can use a variety of materials for this: fabric, vinyl, old tarps) Cut into strips long enough to fit around students' wrists.
- Box of small roundhead brass fasteners
- Adhesive Velcro™ dots
- Box cutter
- Compass

Discussion: What are ways that we can use the sun's energy?

A sundial can be used to tell time based on the movement of the sun throughout the course of a day. To begin:

1. Give each student a watch face and have them color or decorate it. Pass out wristbands and fasteners.

2. Go around the room and position each watch face in the center of the band. Using the box cutter make a small hole in the center of the watch face that goes all the way through the band.

3. Students may now insert the fastener through the back of the band. The metal prongs of the fastener should be sticking out the front of the watch. They should not fold the prongs down. This is the gnomon of the sundial.

4. Give each student Velcro™ dots to attach to the watchband, so they may close them on their wrists. They may need assistance in doing this.

5. Take the sundials outside. Using a compass, find due north. Point the gnomon of your sundial so that it is directed due north. Read the time by observing where the shadow is cast onto the dial. When they are not using the sundial students may fold down fastener prongs, so as not to poke themselves.

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Notes.

Lesson E9 School of the Rising Sun: Focus on PV

How do photovoltaics (solar panels) work?

“Photo” means “light” and “voltaic” means “electricity”. Solar panels are made of a material called silicon, which is a semiconductor, and also the material that makes up sand. To be usable in solar panels, the silicon must be heated to extremely high temperatures and then formed into very thin wafers. Sunlight is composed of tiny particles of light energy called photons. When sunlight strikes a solar panel, some of the photons are absorbed. These absorbed photons dislodge electrons from the silicon’s atoms, producing electricity.

What happens at night or on rainy days?

When the sun stops shining the electrons in the silicon stop moving, thus, no electricity is being produced. To use solar power at night or on rainy days, the electricity produced by the solar panels may be stored in batteries, some of them roughly the size of a refrigerator.

Photo: Der. Metzger, Wikimedia Commons

Photo: Der. Metzger, Wikimedia Commons

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Activity E9a Stuffed Suns

Objectives: Students will...

- Design suns using recycled materials.

Time: 1 hour
Location: Classroom

Materials:

- Drawing paper
- Newspapers markers/paint
- Construction paper
- Scissors
- Stapler
- String

Discussion: How do we use the sun to make electricity?

1. Remind students that they have been studying the sun as a form of energy. Today they will be making suns to hang in the window.

2. Pass out paper markers and scissors to each student. Have them cut out two circles roughly the same size. Explain that this will be the middle of their sun.

3. Pass out construction paper, and have students cut out triangles or rectangles. Explain that these will be their sunbeams.

4. Students should now color their suns. They should color each circle only on one side.

5. Once they have finished coloring, go around the room and help each student assemble their sun. Place the construction paper triangles or rectangles between the circles, so that they protrude like sunbeams. Staple the circles together, colored sides out, leaving about a quarter of the sun unstapled.

6. Pass out newspaper and have students ball up the newspaper and use it to stuff their suns. Be sure they do not overstuff as it will pull out the staples.

7. Once they have stuffed their suns, go around and finish stapling the suns closed. Staple a string to one side so that the suns may be hung in the window.

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ActivityE9b Solar Race Cars

Objectives: Students will...

- Engage in a design project that uses photovoltaic cells to convert solar energy.

Time: 45 minutes
Location: Classroom and schoolyard

Materials:

- Solar Racer kits
- Glue gun
- Multimeter

Discussion: How do solar panels work?

Online resources for ordering solar racers:

- Kelvin - http://www.kelvin.com/
- Pitsco - http://shop.pitsco.com/

Solar racers range in price from $6-$10 per car depending on the size of the order.

Each racer consists of a wood or plastic flat base, axels, wheels, motor and solar panel. For most solar racer designs, a glue gun is needed for assembly. Depending on where the racers come from, the instructions will vary somewhat, but all materials are accompanied by detailed directions.

1. You may have one car per student or have students work in groups. Give out the materials to each student or group.

NOTE:
For grades K-1, assemble 2-3 racers for the class to explore.

2. Students may decorate the base of their racer, and then assemble the car.

3. An adult should use the glue gun to finish construction of each racer.

4. Once the racers are assembled students may take the cars outside to race them or, if it is cold or cloudy, use a gro-light and test out racers in the classroom.

5. If time permits, students may measure the output of the racers using multimeters.

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Notes.

Lesson E10 Solar Heat Energy

If you go to the beach on a sunny day and try to walk across the sand but it is so hot that it hurts your feet, you've experienced an example of solar energy. Solar energy travels to Earth in the form of light. When sunlight strikes the Earth's surface, some of the light is converted into thermal or heat energy. There are a variety of ways we can use solar thermal energy.

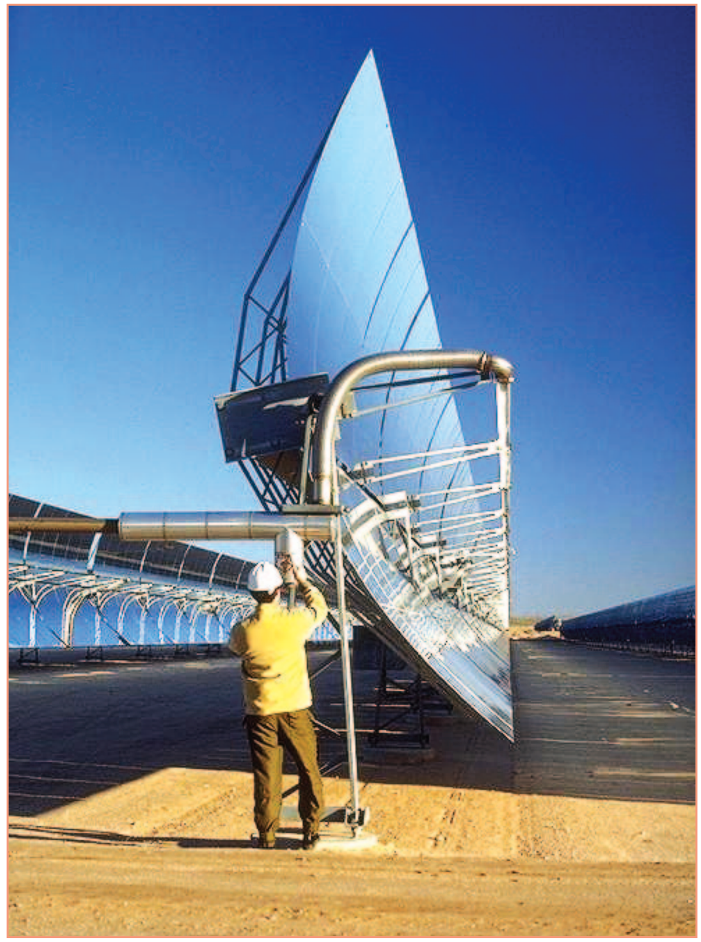

Photo: energylan_sandia,gov

Solar thermal energy may be used to create electricity by heating a fluid that produces steam to run a generator, much like a traditional power plant. It may also be used to heat water or the insides of buildings. There are two types of space heating solar thermal: passive and active.

Passive solar heating in buildings is similar to what happens to your car on a hot day. The heat passes through a surface by convection (less dense warm air rises, while denser cool air sinks). Passive solar heating requires no specialized equipment.

Active solar heating systems require a collector to absorb solar heat. The hot air or heated medium is circulated by fans or pumps. Generally, active solar heating systems have an energy storage device.

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Activity E10 Solar Cooker

Objectives: Students will...

- Explore solar thermal energy by constructing a solar cooker.

Time: 45 minutes
Location: Classroom, schoolyard

Discussion: Thermal Energy from the Sun

There are numerous ways of making solar cookers. The following activity provides instruction for two different solar cookers. Each of these cookers requires only readily available, low-cost or free materials. If you are interested in exploring other methods of building solar cookers, please see the list of websites found in the "Resources" section.

Materials:

- 2 sheets of black poster board
- Aluminum foil
- Cardboard
- Box
- Black construction paper
- Tape
- Glue

Solar Cooker #1

1. Glue two pieces of black poster board together lengthwise, making one long piece. Cover one side with aluminum foil. Glue down foil and smooth out any wrinkles.

2. Roll the poster board, foil side in, into a cone shape and tape it together. The cone should still be open on both ends.

3. Put black construction paper in the bottom of a cardboard box. This dark surface will absorb heat into the bottom of the box.

4. Prop the cone in the box with the narrower opening pointing down. Make sure the cone fits snugly in the box so that it stays upright.

5. Place food inside the cone to cook.

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Activity E10 Solar Cooker

Materials:

- Pizza box
- Black construction paper
- Aluminum foil
- Clear plastic
- Glue
- Tape
- Scissors
- Ruler
- Straw

Solar Cooker #2: Pizza Box Solar Cooker

1. On the top of the pizza box, use a ruler to draw a 1-inch border on all four sides. Cut along three sides. Leave the line along the back of the box uncut.
2. Fold back along the uncut line to make a flap.
3. Cover the inside of the flap with aluminum foil. Glue it down to hold it in place and smooth out any wrinkles in the foil.
4. Cut out a piece of clear plastic large enough to cover the opening left by the flap. Be sure to tape it down tightly, so that no air can escape from inside the box.
5. Cover the bottom inside of the pizza box with aluminum foil, and glue it into place. Then cover aluminum foil with black construction paper, and tape it in place. The black paper will absorb the sun's heat.
6. Close the box and use the straw or dowel, to prop up the flap so that it catches the maximum amount of sunlight.
7. Place food inside the pizza box under the plastic to cook

Using the solar cookers:

To use your solar cookers you will need to do your cooking outside. Once the solar cookers are set up place a thermometer inside to measure how hot it becomes. Your class may construct both solar cookers and compare temperatures or time how long each takes to cook. You may try to make s'mores or English muffin pizzas to test them out.

As you cook, check the solar cooker every 15 minutes. If the sun has moved, adjust the box accordingly.

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Vocabulary

Amperage: the current, or amount of energy flow. Measured in amperes (amps).

Battery: Two or more cells of stored chemical energy that can produce electricity.

Carbon Footprint: The total amount of greenhouse gas emissions caused by a place, organization, or even a person.

Circuit: A device that provides a path for an electrical current to flow.

Climate Change: Changes in the Earth's weather patterns that occur over a long period of time, most recently due to the rise in the Earth's average temperature.

Compact Fluorescent Light (CFL): A type of fluorescent light that on average saves 60% on energy consumption compared to a typical incandescent light bulb.

Electricity: A form of energy; the flow of electrons along a conductor.

Energy: The capacity to do work.

Energy efficiency: To reduce the amount of energy required to provide products and services.

Energy Star: a joint program of the U.S. Environmental Protection Agency and the U.S. Department of Energy helping to save money and protect the environment through the use of energy efficient products and practices.

Fossil Fuels: Minerals and elements found in the Earth that were formed over millions of years and contain stored energy. Common fossil fuels include coal, oil and natural gas.

Geothermal Energy: Harnessing energy using the temperature difference between the earth's surface and crust.

Hydroelectric: Electricity generated from water.

Kinetic Energy: Energy of motion.

Magnetism: A force by which objects are repelled or attracted to each other.

Multimeter: An electronic instrument used to measure electrical quantities.

Potential Energy: Energy that is stored.

Power Plant: A facility that generates electricity, usually by burning a fossil fuel.

Photovoltaics: Photo = light and voltaics = electricity. A scientific term for solar panels, which convert the sun's light energy into electricity.

Renewable Energy: Energy generated from natural resources such as sunlight, wind, rain, tides, and geothermal heat; resources that are naturally replenished or infinite.

Solar Energy: Energy from the sun.

Thermal Energy: Energy created from a difference in temperature. Also known as heat.

Voltage: Rate at which energy flows. Measured in volts.

Watt: A unit of power. Also, kilowatt (kW) 1000 watts = 1 kW).

Wind turbine: Wind turbines use wind energy to rotate a turbine that creates electricity.

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Resources & Additional Information

Websites

KidWind
http://www.kidwind.org/

Sells kits for building wind turbines as well as some solar materials.

Kelvin
http://www.kelvin.com/Merchant2/merchant.mv?Screen=CTGY&Store_Code=K&Category_Code=TRLASR

Educational science supplier. Sells reasonably priced solar race car kits.

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Notes.

the green design lab™

SOLARone
GREEN ENERGY, ARTS & EDUCATION CENTER

The Green Design Lab™ is a curriculum resource and guide for making your school a healthy and green place to work and learn.

Using a creative approach to problem solving and sustainability education, the Green Design Lab™ uses your school building as a laboratory for hands-on learning about green technologies, design process, engineering and applied science.

The goal is to help students make connections between the buildings we use every day and their ecological footprint. Complete with an adaptable array of lesson plans, projects and ideas, the Green Design Lab™ is a starting point for thinking about sustainability in your school and local community.

The Green Design Lab™ is also a great way to introduce students to the emerging fields of green jobs, providing opportunities to learn practical skills ranging from building performance to urban farming.

This unit introduces students to conventional methods of energy production, energy infrastructure and its impacts on human health and the environment. Students will investigate the science of electricity as well as energy conservation strategies and forms of renewable energy. Using the school as a learning laboratory, students will explore the concepts of building science and energy efficiency. Students will also consider new technologies and applications through a series of hand-on projects.